NASA SBIR/STTR Technologies

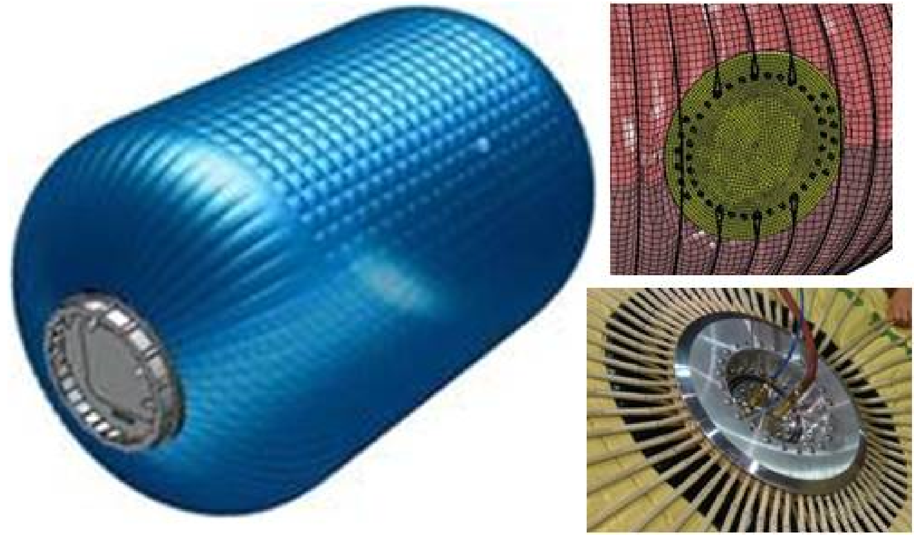
H5.01-9816 - Lightweight Inflatable Structural Airlock (LISA)

PI: Essam Sheta
CFD Research Corporation - Huntsville, AL

Identification and Significance of Innovation

Innovative light-weight airlock technologies that protect habitable environments and reduce operational and logistical overhead are required to integrate with deep space and surface EVA-hosting systems.CFDRC research team proposes an inflatable airlock structure that employs unique fabric architecture capable of delivering the lowest mass and greatest versatility of any competing design.The proposed airlock design features a completely integrated air beam inter-wall to passively generate the wall stiffness required for airlock depressurization?without the mass and bulk of aluminum pressure hulls or multi-structure adaptations.This unique architecture utilizes a matrix of braided fiber tendons to contain the structure global pressure loads.The underlying woven fabrics are thereby only exposed to minimal local shell loads.Working in pure tension in the absence of load coupling, the tendon array has been shown to be statically determinate and auto-stabilizing under extreme deflection

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)



Technical Objectives and Work Plan

The overall objective of this SBIR is to design, fabricate, and test a Lightweight Inflatable Structural Airlock (LISA) design that employs unique fabric architecture capable of delivering the lowest mass and greatest versatility of any competing design.The Ultra High Performance Vessel (UHPV) will be used as architectural basis for the proposed inflatable airlock design. UHPV brings unprecedented structural determinism and scalability to the realm of high shell load inflatable architecture, along with performance predictability that allows the design to be fully characterized and validated analytically without the need for extensive testing. The conceptual inflatable airlock architecture will be designed in Phase I. The design configuration will include details of all primary structural components and identify material selections. A subscale LISA hardware item will be fabricated and assessed for feasibility demonstration. In addition, high fidelity physics-based computational method will be utilized to fully characterize the system structural and dynamic performance under different inflation and environmental conditions.Based on these analyses and customer supplied mission requirements, materials evaluation will be conducted to select the appropriate candidate materials. The proposed analysis and component testing are packaged to fully characterize the performance of the proposed concept and to capture the combined effect of manufacturing, assembly, storage and deployment.

NASA Applications

The proposed inflatable airlock design will have immediate application in expanding the utility of ISS as well as future space habitats while benefiting from system cost and payload volume reduction. Direct NASA applications include inflatable structures programs such as lunar surface habitation architecture, rover vehicles, telescopes, antenna reflectors, cryogenic propellant tanks, debris shields, rescue vehicles, barometric chambers, and large-scale space hangars for on-orbit assembly.

Non-NASA Applications

General applications include underwater habitats, underwater emergency escape systems, portable storage tanks for oil transport, aerostats, compressed air energy storage, remote fuel depot stations, remote water storage tanks for forest fire control, deep space antenna reflector for ground stations, antenna radome, emergency shelters, and troop shelters with integrated ballistic protection.

Firm Contacts

Deborah Phipps
CFD Research Corporation
701 McMillian Way NW, Suite D
Huntsville, AL, 35806-2923
PHONE: (256) 726-4800
FAX: (256) 726-4806